Light and Lighting

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100 Years Ago

While such famous landmarks as Somerset House and St. Paul's Cathedral have not altered in a hundred years, as the reproduction of this mid-nineteenth century lithograph shows, scientific developments have made undreamed-of advances in our way of life.

The progress of the modern electric lamp is a record of the ceaseless research of Members of the Electric Lamp Manufacturers' Association. Without their progressive co-operation electric lighting could not have reached its present stage of excellence. In making the highest possible efficiency their constant aim, and never admitting the impossibility of still further improvement, they have made available an unsurpassed service to the community.

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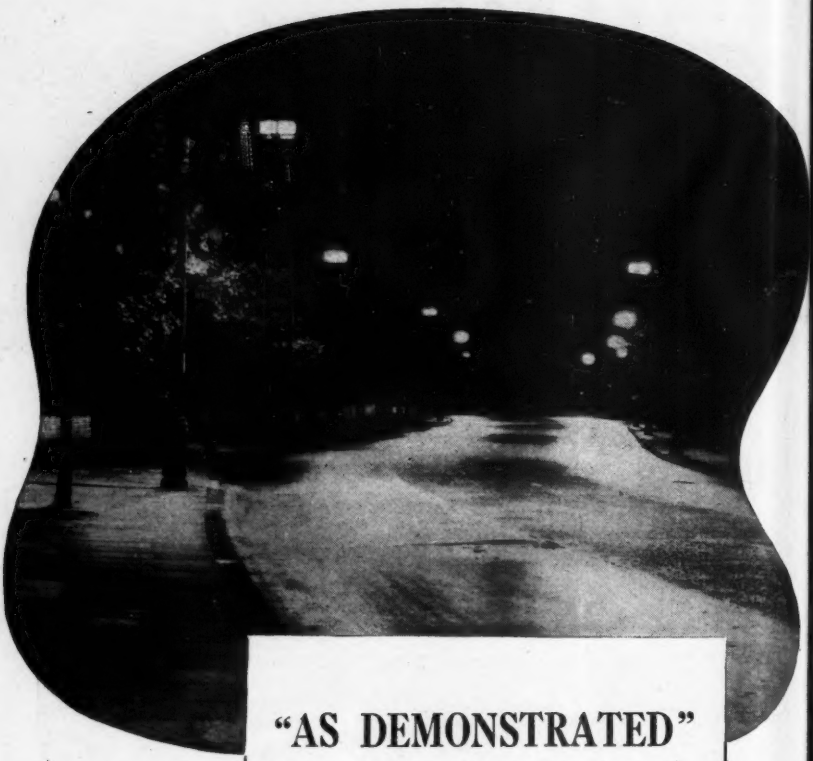

"AS DEMONSTRATED"

Here is one of the demonstration lighting systems seen at the Southport conference of Public Lighting Engineers. It makes use of double-unit gas lamps, mounted at a height of 21 ft. 6 inches, and provides Class "A" lighting of considerable power for main traffic routes or shopping centres. Such systems show how existing gas lighting installations can be modernised, with minimum demands on labour and materials, to conform with the recommendations of the Ministry of Transport Committee on Street Lighting.

NOTE: *A handy booklet "Light on the Roads," which summarises and illustrates the main recommendations of the Committee, can be obtained free from the address below*

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Lighting and Films

THE recent I.E.S. paper on **Illumination in Motion Picture Studios** (see p. 73) provided an interesting evening. The three authors aptly took up the tale in turn and their remarks were enlivened by pleasing films and colour-photographs—terminating with the famous scene in Henry V ("Tennis Balls, my Liege!").

Much is heard of the genius of producers of films, of the charm and foibles of stars in the cinema world. Be it remembered, however, that the prime essential in the making, as well as in the showing, of films is **Light.**

Sources used in motion picture studios have to meet much more arduous conditions than in the past. Colour-rendering and absence of sound are now of vital importance. The paper showed how well the lighting industry has already risen to the occasion. Some of the latest sources, such as the three-carbon arc described at the meeting and the high-pressure compact source discharge units, may well play a major part in the future.

Illumination Notes and News

I.E.S. Presidential Visit to Scotland

The arrangement whereby the Glasgow and Edinburgh Centres of the I.E.S. hold their meetings on adjacent days enabled the I.E.S. President, Dr. J. W. T. Walsh, and the I.E.S. Secretary, Mr. G. F. Cole, to be present at the annual general meetings and the annual dinners of these centres last month.

Some 70 members and friends attended the annual dinner of the Glasgow Centre on March 18, when Mr. V. P. MacNaughton, the Centre chairman, presided. After the dinner Dr. Walsh presented a shortened version of the presidential address which he originally gave in London last October. As has been his custom in presenting his address in the provinces, Dr. Walsh invited a discussion on the views he expressed regarding the training of the lighting engineer. One of the points made in the discussion was that though it was desirable that those seeking qualification as lighting engineers should have a sound general education, care should be taken that entry into the profession was not debarred to those engaged on the practical side of lighting installation. Some doubt was also expressed regarding the value of examinations.

Dr. Walsh agreed that those on the practical side of lighting should be encouraged to qualify as lighting engineers, and in this connection he congratulated Mr. F. M. Hale on the success of the courses which he had arranged in Glasgow during recent years. With regard to examinations he said that though they had their drawbacks no really satisfactory alternative had been produced.

The following day the president repeated his address after the annual dinner of the Edinburgh Centre. The chair on this occasion was taken by Prof. M. G. Say, who welcomed the president and secretary to Edinburgh.

A number of members took part in the discussion, during the course of which the hope was expressed that due attention would be given to the admission to the register of those older members who had been engaged in the profession for many years. Mr. S. G. Batt, Vice-Chairman of the Centre, said that he hoped that the greatest care would be taken in examining applications for inclusion on the register to ensure that the necessary standard was maintained.

I.E.S. Summer Meeting

The Final Notices in connection with the I.E.S. Summer Meeting, which is to be held at Harrogate from June 16-18, have now been circulated to all I.E.S. members. The notice includes the full details of the programme of papers and social events.

I.E.S. members intending to be present at the meeting are urged to complete the form and return it to the I.E.S. secretary with their remittance to cover registration fee, cost of tickets, etc., as soon as possible. Members wishing to reserve accommodation must return the form *not later than May* 21.

Photograph taken after the Annual Dinner of the Edinburgh Centre of the I.E.S. on March 19th. In the front row from left to right are Prof. M. G. Say, Chairman of the Centre, Dr. J. W. T. Walsh, I.E.S. President, and Mr. G. F. Cole, I.E.S. Secretary. *(The photograph was taken by Mr. J. S. Galbreath)*

Birmingham I.E.S. Centre "News Letter"

We have several times referred to the "News Letter," circulated by the I.E.S. Birmingham Centre, which keeps members in touch with what is going on—not all members are able to attend every meeting! In the January letter we noted another good feature, namely, an account of the centre management, the various honorary officers and the nature of the duties they perform for the Centre, often quite onerous ones. Members as a whole do not always realise how much is done in this way on their behalf and for the benefit of the Society, and it is well that this should sometimes be called to mind. In this case, it is stated, the officers and committee spend about 2,000 man-hours per annum on committee work alone. One result of this assiduity is that the Birmingham Centre has steadily increased its membership year by year, ever since it was originally started.

Present Trends in Daylight Studies

An informative paper on the above subject was read before the I.E.S., Sheffield Centre, on March 1, by Mr. W. Allen, who repeated his address to the Leeds Centre on the following day. The paper contained an analysis of recently obtained statistical data on both natural and artificial lighting in the home. There seems now to be a better appreciation of the value of good natural lighting, as is evident from opinions expressed by occupants of houses built fairly recently. Turning to school lighting, Mr. Allen stressed the importance of arrangements which helped to *concentrate attention.* For this purpose the teacher and the blackboard should be strongly lighted and surroundings should be relatively subdued—even an unduly bright window area sometimes proving a drawback.

International Commission on Illumination

After an interval of nine years, the International Commission on Illumination will be holding its eleventh Plenary Session in Paris this year. The meetings will be held during the period June 29 to July 7 inclusive, at the Maison de la Résistance Alliée, 53, Rue François 1er, Paris 8e.

The war interrupted and to a considerable extent, disorganised the work of the Commission, and for various reasons certain National Committees will be unable, on this occasion, to be represented fully at the meetings. However, some ten or a dozen Committees out of the pre-war membership are almost certain to be represented.

One of the results of the war is a need, which in some quarters is urgent, for the dissemination of information on scientific matters which was acquired during the war. The Commission's technical reports, most of which are already in the hands of the printers, promise to be of great service in this respect. Those relating to basic subjects, such, for instance, as visual photometry, physical photometry, and light and vision, have been prepared under the personal supervision of men whose names are familiar in their subjects throughout the world.

The official programme includes meetings of the twenty-five technical committees of the Commission, while the programme of visits and social events being arranged by the French Committee includes a civic reception, visits to several places of exceptional interest, and, finally, a tour in Normandy, including visits to the landing beaches. This last event will take place on July 8 and 9, after the end of the official meetings.

Attendance at the meetings will be open to anyone, but applications must be made on the official form which will shortly be obtainable, together with a copy of the full official programme, from the Secretary of the National Illumination Committee of Great Britain. Individuals not nominated as official delegates by the National Committee will, of course, have to make their own arrangements for obtaining French currency.

I.E.S. Visit to I.C.I., Plastics Division

On Tuesday, March 23, a group of I.E.S. members spent a most instructive afternoon at the Plastics Division of Imperial Chemical Industries, Ltd., at Welwyn Garden City, where they were shown many interesting examples of the application of "Perspex" to optical and lighting practice.

In the Technical Service Department, demonstrations were arranged of the processing of "Perspex," including moulding by air pressure, and the "vacuum snap-back" methods. In the lighting laboratory, Dr. Harper described the methods of testing transmission factor of "Perspex" sheet, and described heat tests carried out on "Perspex" fittings.

The party then proceeded to the Optical Development Department, where Dr. Starkie, in a most interesting survey of the development of plastic optical materials, explained their application to television systems, projection screens, and industrial magnifiers, and gave demonstrations of Schmidt-plate systems and prism-controlled screens.

The visit concluded with a tour of the workshops, mould polishing departments, and laboratories, which enabled members to watch the cutting, grinding, and polishing of lenses and Schmidt-plate moulds.

During the tea interval, Mr. Cunnington took the opportunity of expressing the members' appreciation of the visit, and thanked Dr. Childs and his colleagues for their hospitality, and for the excellence with which the tour and demonstrations had been arranged.

Photographic Illumination in Motion Picture Studios

Summary of a paper read by Mr. F. V. Hauser, Dr. F. S. Hawkins and Mr. W. R. Stevens at the meeting of the Illuminating Engineering Society held in London on April 13.

In addition to obtaining a consistently exposed negative the lighting cameraman in a film studio must be able to accentuate what is required by the director in order to produce the desired effects. The fundamental requirement of studio lighting is that sufficient light should be directed as required on to the various portions of the set. The usual procedure is for the set electrician to arrange the lamps around and above the set when the latter is being prepared and then for the lighting cameraman to arrange his key lighting as required. To assist in achieving a suitable balance more lamps are rigged on the set than are required for any one scene, and on large sets there may be as many as 200 separate lighting units to adjust. With colour productions the number and power of units is usually greater than with black and white films.

It follows that studio lighting fittings must be transportable and of such dimensions that they can be rigged upon cradles, which may be 35 ft. above floor level; and in order to minimise the number of types of fittings they must be capable of providing a wide range of light distributions. The basic requirement is therefore control, both in the handling and direction of the fitting and of the light beam itself.

Fittings are therefore divided into two groups, spotlights in which the divergence of the beam is varied between 10 deg. and 50 deg., and general lighting units which give a beam whose divergence cannot normally be varied. The power supply is usually 115 volts D.C. and fittings range from 100 watt tungsten filament lamps to the 17-kw. high intensity arc lamp.

With the present panchromatic negative film stock, for black and white photography key intensities of from 80 to 120 lumens per sq. ft. are usual, though for special types of photography these may be considerably increased. "Key intensity" refers to the illumination falling on the principal artistes or objects which are to be featured. In colour photography intensities vary between 500 and 1,000 lumens per sq. ft. and higher.

Light Sources

Incandescent tungsten lamps are used in powers and sizes ranging from 100 watts to 5 kw., their lumens/watt ranging from 22 to 28 with an average life of 100 hours, at colour temperatures between 2,900 deg. K. and 3,200 deg. K. Special colour photography tungsten lamps are also used, the colour temperature being increased to 3,400 deg. K. These lamps are used for close-ups and for positions near the microphone; their life is limited to 10 hours.

Prior to 1926, carbon arc lamps were employed for studio lighting, but with the introduction of panchromatic film their use was restricted to special effects. The carbon arc still occupies this position in the black and white field, but the introduction of colour processes and the development of a full range of high intensity arcs giving light of an appropriate colour brought the carbon arc back into use as the main light source for colour film production.

A further light source, which has recently been introduced for colour photography, is the colour-corrected M.V. lamp. Experimental full-scale tests, which are now in progress, have shown that these lamps provide a highly efficient source which is silent in operation and free from other disadvantages found with other light sources. There are, however, some operational difficulties at present associated with the running of these lamps, such as the length of the run-up time from a cold start and the high voltage of the pulse required to start them when hot.

Electricity Supply

Steady and continuous illumination is essential for the satisfactory photography of a set, and must not merely appear to be so owing to the persistence of vision. As a result lamps are generally supplied with direct current to avoid stroboscopic effects occurring between the camera shutter and cyclic variations in the output of light. A large stage may require about 20,000 amperes at 115 volts.

Artificial Light or Daylight?

In what follows an account is given of a debate which took place at an informal meeting of the I.E.S. in London on February 24, 1948

At an informal meeting of the Illuminating Engineering Society on February 24, a large gathering of the members argued the proposition "That artificial lighting is an adequate substitute for daylight." This was proposed by Mr. N. Sizer, who made his case in a speech in which serious argument and jocular gibes at his opponents were entertainingly mingled. He first referred to the difficult problem of the large office block. The architects did their best to provide some daylight by means of light walls, but these were expensive owing to the very high site values prevailing in the centres of towns and the amount of light they provided was often miserably inadequate. In many such blocks it would be found that artificial light was on all day. This spoke for itself and Mr. Sizer said he would take the bull by the horns and confidently affirm that artificial light was superior to daylight in many respects. It was more uniform and it conserved the heat which was otherwise lost through the windows. This loss was very serious in the case of the large windows necessary to provide a good standard of daylight. Wartime experience in blacked-out factories had shown that the continuous use of artificial light was not accompanied by any ill effects on the workers; it had, in fact, proved conclusively that artificial lighting was an adequate substitute for daylight.

Mr. P. V. Burnett then opposed the proposition on three grounds, psychological, aesthetic, and economic. There was no shadow of doubt that the generality of people wanted daylight in preference to artificial light. For instance, in one of the blacked-out factories which had been referred to there was great discontent with the conditions until some, at least, of the daylight had been restored. Aesthetically, the proposition was quite untenable. To be convinced of this one had only to contrast the beauty of well-designed windows, not only cathedral windows but the windows of Georgian domestic architecture, with the hideousness of the modern fluorescent tubes which had, perhaps reached its climax in some of the street-lighting installations now being put up. One the score of efficiency Mr. Burnett contrasted the reliability of daylight with some of his experiences during the periods of load-shedding. He mentioned the cost of fittings and accessories and concluded by contrasting the free and plentiful supply of daylight with the price which had to be paid for artificial light in the form of precious fuel.

The supporter of the proposition was Mr. L. H. Hubble, who said that it was quite possible to create conditions of artificial lighting which were wholly satisfactory both aesthetically and psychologically. Nature provided for part of the time what the lighting engineer could produce all the time or for as long as it was needed. In any case the artificial lighting system had to be there so that the only cost involved in substituting it for daylight was the additional power supplied and a slight reduction in the life of the equipment. Windows were liked, not because of the light they admitted but for the view of outdoors which they provided, with the accompanying sense of liberation.

Mr. W. Allen, supporting Mr. Burnett, drew attention to the fact that artificial lighting was, in fact, ultimately derived from the sun, the direct source of daylight. A room with south-facing windows, he said, gained a valuable amount of warmth in addition to the light it enjoyed. In America buildings had been erected without windows, and some personnel officers had reported that the workers preferred the artificial light to the daylight because of its lack of variability but this very uniformity, the speaker felt, was a fatal objection to the system; in this country, at any rate, we did not like monotony. Artificial lighting was very useful as a supplement to daylight when the latter was insufficient but supplementation was a very different thing from substitution.

In the general debate which followed the four opening speakers, several members took up points which had been mentioned by them. For instance, it was pointed out that the efficiency of the daylighting in a building was, in

reality, the efficiency of the architect. Mr. F. C. Smith said that it was of no use for the scientist to ask for proof of what was, in fact, a perfectly obvious and commonsense proposition. It was difficult to prove the need for a given standard of ventilation but, as with fresh air so with daylight, people liked it and we all knew it was good for us.

Mr. Penny struck a more jocular note when he said that he deplored all this passionate desire to make working conditions pleasant and attractive. People hated work and only did it because they were forced to, so any attempt to make a work place a pleasant place was ill-judged and should be abandoned One speaker said that artificial lighting had been found a useful substitute for daylight on the poultry farm, where it had been used to induce the hens to increase their egg production under the impression that the days were longer than they really were. The use of artificial lighting in coal mines, where daylight could not penetrate, was also mentioned.

Dr. Ballin said that the colour of artificial light could be controlled, whereas daylight was more or less fixed and was certainly uncontrollable in this respect. He was followed by another speaker, who asked whether the "little daylight" mentioned by Mr. Burnett as giving relief in a blacked-out factory was necessarily real daylight, and, pursuing this point, Mr. S. D. Lay said that it was quite easy to imitate a window with artificial lighting so there seemed to be no reason why artificial windows should not prove adequate substitutes for the real thing as far as the illumination was concerned. The valuable function of a real window was, he contended, the opportunity which it gave for seeing out of the room, but this fact did not invalidate the proposition that artificial lighting was adequate as a substitute for lighting by daylight. Mr. Greenslade then took up Mr. Allen's point about the admission of warmth with sunlight. He said it was curious that for artificial lighting and heating we used separate appliances; why could they not be combined? It was necessary to realise that as sources of either heating or lighting windows were of no use in the winter time.

Mr. Dow then spoke of the superiority of artificial light from the point of view of illumination pure and simple, but he emphasised the hygienic value of daylight and quoted the old saying that "where the sun does not enter, the doctor comes." The fact that windows provided a view of the outside world had been used in the United States as an argument for the total exclusion of daylight, as it was claimed that they were a source of distraction to the workers and were therefore better blocked up. This argument Mr. Dow described as "soulless" and not to be tolerated. Dr. Walsh said that if the motion were to be read literally it could not be sustained; there were certain processes for which artificial lighting could not be used satisfactorily and therefore, while he might follow Mr. Sizer 95 per cent. or even 99 per cent. of the way, he could not agree that artificial light could properly be regarded as an entirely adequate substitute for daylight. Mr. J. Swarbrick said that the attitude of the workers in a blacked-out factory might be summed up in the phrase that the lighting was "perfect for working by but lovely to get away from."

Mr. Sizer then replied briefly to various points which had been raised during the debate. With regard to the heat which was admitted to a room with natural daylight, he said that this took place principally at a time of year when it was not wanted. It was remarkable that those in the film industry who had started by using all the daylight they could get now worked almost entirely by artificial light; this was a great tribute to the degree of control which was possible with this form of lighting. He would sum up by saying that daylight was quite satisfactory so long as it could be boosted with artificial light; he assumed, however, that the proposers of the motion would, when they reached home that evening, dispense with the artificial light, pull up the blinds, and enjoy the amenities of the natural lighting.

Mr. J. M. Waldram, who occupied the chair during the meeting, said that he had no intention of summing up the debate and no vote would be taken. He would, however, remark that, contrary to what had been said, daylight was not free; in fact, the cost of providing it in a built-up area was often very high. In New York he had noticed that in the newly developed areas the blocks were much more widely spaced than in the older parts, indicating a growth of appreciation of the value of daylight.

Colour-Mixture

At the meeting of the Colour Group held at the Imperial College on February 11, Dr. D. R. Duncan, of the Paint Research Station, Teddington, read a paper on "The Classification of Colour-Mixture Phenomena." He said that the ordinary division of colour mixture simply into additive and subtractive was not by any means either adequate or satisfactory, although it was almost universal in the literature of the subject. There were two types of additive mixture which he called respectively the integrated and the averaged. The former referred to the addition of coloured lights while the latter included such mixing devices as multi-coloured mosaics and revolving coloured discs. Subtractive mixture again could be divided into integrated or averaged, and Dr. Duncan illustrated this with coloured transparent liquids; in one case light was transmitted through two bottles one behind the other and each containing one liquid, while in the other case it passed through a mixture of the two liquids in a single bottle.

One important difference between additive and subtractive mixtures was that, with the former, the colour of the mixture could be found from the chromaticities and luminances (brightnesses) of the components, whereas with the latter it was necessary to know the spectral distribution of the light and the spectral transmission (or reflection) curves of the components in order to find the colour resulting from the mixture.

A third type of mixture, neither purely additive nor entirely subtractive, was pigment mixture. In this case, in order to find the colour produced by reflection or by transmission, it was necessary to know the variation with wave-length of both the coefficient of scatter and the absorption factor of the components, as well as the spectral distribution of the incident light. Dr. Vernon showed how the calculation could be made and gave instances of results quite different from those that would be expected on the ordinary simple theory of subtractive mixture. He exhibited samples of pigment mixtures which had been made up by calculation to give a match with certain other pigments of quite different composition.

Standardisation

I.E.S. members should not forgo the chance of reading the inaugural address to the Institution of Electrical Engineers of Mr. Percy Good (one of their own past presidents).

The full title of this address, delivered on October 9, 1947, and now reprinted, was "The History and Philosophy of Standardisation." It has always been a strong point of the B.S.I. that the philosophical aspect—involving human reactions to standardisation—has been kept well in mind.

In the early part of his address Mr. Good referred to the passing of two new Acts of far-reaching importance to the electrical industry, involving the nationalisation of Cable and Wireless and of electric supply. Some form of public control, he held, was inevitable for a nation-wide service where competition was unwarrantable, but this control should not extend to the manufacturing side.

Reviewing the development of industrial standardisation Mr. Good traced the growth and extension of the movement, ramifying in so many fields. He presented an impressive graph illustrating the development of the work of the B.S.I., responsible now for nearly 2,000 standards and an annual expenditure exceeding £100,000. The number of committee members has advanced from eight in 1901 to 11,300 in 1947! He discussed standards of performance, dimensional standards, and sampling and certification marking—pointing out that the use of a certification mark indicating conformity with a standard does not in any way diminish the value of goodwill. Thus, in the jewellery trade, the position of the industry was strengthened by the process of hall-marking gold and silver goods, introduced as early as 1300.

In the concluding part of his address Mr. Good referred briefly to problems involved in nomenclature and the use of symbols, finally quoting the following maxim as expressed by Francis Bacon:—

"I hold every man a debtor to his profession from the which, as men of course do seek to receive countenance and profit, so ought they of duty to endeavour themselves by way of amends to be a help and ornament thereunto."

Association Française des Éclairagistes

The following is an account of the meeting of the above association which was held in Paris on March 5 and 6.

An interesting series of papers was presented at a recent convention of the Association Française des Eclairagistes held in Paris on March 5 and 6, 1948, under the presidency of M. J. Dourgnon. Among foreign visitors were Dr. N. A. Halbertsma, of the Netherlands, President of the International Commission on Illumination; Mr. J. S. Preston, Secretary of the International Commission and a Vice-President of the I.E.S., and Mr. J. M. Waldram, Senior Vice-President of the I.E.S., both from Great Britain.

March 5 was devoted to fluorescent lamps and lighting, when no fewer than 11 papers were presented on both mains voltage and high voltage tubes. The morning session opened at 9 a.m. with a paper by Dr. Kellershorn, of the Faculté de Médecine, who examined the properties of fluorescent lamps in relation to vision, discussing the effects of low brightness, large size, special distribution and flicker with the visual requirements of contrast, acuity, background and surround brightness, shadows, and the like. Though the large size and low brightness were valuable he suggested that the solid angle subtended by the source might be too large, and called for masking of the source for tubes close to the observer. He examined the possibility of the emission of short-wave ultra-violet radiation from the tubes, a point which was vigorously discussed.

M. Mouton, of the Fabriques Réunies des Lamps Electriques, described the electrical characteristics of the fluorescent lamp and the possible electric circuits, most of which are familiar. Dr. Merry Cohu, of Messrs. Philips, discussed problems of photometry of fluorescent tubes, including the errors to be expected when making candle-power measurements at short distances; methods of deriving flux from measurements of maximum candle-power, and problems involved in the photometry of fittings. He mentioned the errors due to the insertion of the measuring instrument into the circuit, and those due to the change of temperature of the lamp when it is inserted into the fitting.

M. Wetzel (Cie des Lampes) described experiments with models using small tungsten festoon lamps to simulate tubular fluorescent lamps. The coefficients of utilisation were found for bare lamps for a number of rooms of various sizes, shapes and decoration schemes, and the results were checked at a few points by measurements made at full scale. A paper by M. Pagès (S. A. Holophane) was presented by Mlle de Vilmorin, in the absence of the author through illness. M. Pagès discussed the design of optical elements for lighting equipment using fluorescent lamps. In the design of reflectors it was important to avoid reflecting the light through the lamp. The paper discussed various mathematical forms of reflector such as the circle, logarithmic spiral, cardioid, and ellipse and their properties. The difficulty of producing a concentrated beam, and the problems of equipment using multiple lamps, were mentioned. Refracting equipment design proceeded much as for tungsten filament lamps, but special care was needed to avoid a double beam when two lamps were used, and prismatic reflectors would not work with fluorescent lamps. Designs were shown with reflecting and refraction equipment used in combination.

In the afternoon the discussion proceeded on fluorescent light sources and their application. M. André Claude discussed high voltage tubes of both cold and hot-cathode types, and showed illustrations of a number of interesting installations. M. Chappat followed with a paper on low-tension tubes and fittings. He mentioned the difficulty of achieving higher levels of illumination by the conventional tungsten filament installations; indirect lighting was troublesome at high illuminations. The fluorescent lamp, he said, provided a new palette of colours and the bluer or colder the colour chosen, the higher must be the illumination if a satisfactory impression was to be obtained. The lamps themselves should be shielded from direct view and a technique different from that used with tungsten filament lamps was called for; the light from fluorescent lamps could not be controlled with the same precision. He illustrated a number of fittings of interesting design, many of

which employed louvres or "egg-crates" which could be used to form a grid, with tungsten lamps at the intersections; louvres could also be used to keep the ceiling brightness low when the illumination exceeded 10 lum/sq. ft. M. Dourgnon presented a paper on Fluorescent Tubes and Colour, and M. Blot, of Sté. Philips, discussed Fluorescent Tubes Used as Auxiliaries to Daylight.

A feature of the Convention was the presence of a number of architects, decorative artists and experts on town planning. The latter took part particularly in the proceedings on the second day, Saturday, March 6, which was devoted to Street Lighting. After the annual general meeting of the Association, at which M. Gaymard was elected President for the forthcoming session, M. Prothin, Director-General for Town Planning and Housing, took the chair for a paper by M. J. Fackler, of the Ministry of Town Planning, on the subject of "The General Principles of Town Planning and their incidence on Public Lighting," a paper which was of great interest and which was energetically discussed by both illuminating engineers and town planners.

M. Fackler expounded the general ideas of town planning and zoning, the characteristics of the streets to be found in the various zones and the use to which they are put. He stressed that a town is a living organism and is not static, and that installations must take account of possible future developments. It was most important that the street lighting engineer should work with both the town planner and the architect. He mentioned the conflicting desires of motorists and pedestrians, and the need to avoid sharp contrasts between installations. Tree-lined roads presented a problem seldom encountered in England. The development of inadequate existing roads whereby they could carry more traffic was mentioned, and attention was drawn to British designs of two-level roundabouts for the intersection of main arterial and less important roads. "Specialist" roads called for a different treatment and special problems occurred with tunnels, bridges and squares. Lanterns were frequently used attached directly to buildings, and he discussed the provision of electrical conductors on roofs and in façades of buildings, and the need for provision of electrical gear in new buildings for public lighting. Finally, he showed illustrations of housing schemes in various countries in which the houses were arranged not on the conventional plan with more or less straight roads, but quite irregularly over the site—an arrangement which greatly increases the interest of the situation, but sets quite new problems in public lighting.

In the discussion, mention was made of excellent results which, it was claimed, had been achieved in Switzerland, and of experiments with the floodlighting of buildings and with lighting from very high lanterns. It was thought that, though fluorescent lighting was interesting in this connection its possibilities had yet to be investigated. Dr. Halbertsma stressed the importance of making plans and technical provisions well in advance. At the present time everyone was too poor to make lavish installations but nobody was too poor to study.

It was a comment on the keenness of the French illuminating engineers that their conference continued into Saturday afternoon in a joint meeting with the Société Française des Electriciens, under the chairmanship of M. Ailleret, president of the latter body. M. Gaymard explained some of the basic problems of street lighting, and introduced Mr. Waldram, who gave a paper on the Importance of Brightness in Public Lighting. After paying tribute to the French illuminating engineers, he drew attention to the differences in the lighting problem presented by roads in different countries, and the differences in practice which result. He stressed the importance of perspective geometry, and demonstrated the conception of building up a street lighting installation in perspective from the individual bright areas associated with each lantern (which will be familiar to British engineers) and principles of design on curved roads. Problems of glare, arrangement and light distribution and the uni-directional method of lighting one-way roads were discussed. Typical British equipment was described, including lanterns for fluorescent tubes. The paper was discussed by a number of speakers.

In the evening members inspected an interesting example of fluorescent street lighting in Avenue du Président Wilson, a double-carriageway thoroughfare normally lighted by tungsten filament lanterns.

The Weathering of Materials Used in Outdoor Lighting Equipment

By C. A. MORTON, B.Sc., A.M.I.E.E., F.I.E.S.,*

General

The period between the two world wars brought into use many new materials for the manufacture of lighting equipment. The street lighting lanterns of the early twenties were relatively simple, both optically and mechanically. They usually consisted of a metal housing, a glass covering for the light source, and possibly a prismatic device for redirection. The metal of the housing was usually cast iron for small fittings and copper spinnings (to keep the weight low) for larger fittings.

No great change took place in the design of street lighting lanterns until around 1933, when the high pressure mercury vapour lamp was introduced for street lighting purposes. The first lanterns in which this lamp was used took the rather original form of an assembly of rectangular flat pieces of glassware held together in a framework of copper extrusions. However, although such designs were often very attractive, this type of construction was expensive. The simplification of such a construction led to the replacement of the complex of prismatic and diffusing glasses by a simple refractor unit. This is the now familiar refractor bowl.

Housings for these refractor bowls were based on the use of the copper spinning, hitherto associated with general service lamps. It was found, however, from a study of the photometric performance of assemblies of bowl refractors and mercury lamps and of dome refractors and tungsten filament lamps, that consistent results were difficult to obtain with the relatively large dimensional tolerances in the assembly of the many component parts of the lantern. Experience had also begun to show that excessive vibration, as on trolleybus poles, revealed mechanical weaknesses in some spun bodies. It was thus desirable both for photometric consistency, and also mechanical strength, that the housings of street lighting lanterns, whether using mercury or incandescent lamps, should take a more precise form and from the additional aspects of economics and weight, aluminium began to be a prominent metal in street lighting lanterns.

During this period a somewhat similar trend was developing in the field of floodlighting. The early floodlights consisted largely of spun copper housings. These were, in general, satisfactory for decorative work, but their growing use for such industrial purposes as in railway marshalling yards called for more robust and water-tight fittings. Because of weight, cast iron was avoided, and floodlights with cast aluminium alloy housings came into existence.

Long experience had shown that cast iron, properly painted, gave no weathering troubles. Spun copper housings also had high corrosion resistance, and the glassware used in lighting equipment could be regarded generally as free from atmospheric attack. A new metal was now introduced into the illuminating engineering field, and its weathering properties were very difficult to determine.

Aluminium Castings

A wide range of aluminium alloys is available, and each has properties that render it suitable for a particular combination of applications. Aluminium is also available in sheet form to a very high degree of purity. Weathering properties vary greatly. One alloy may remain comparatively untouched out of doors; another may require particular attention to its protective treatment in order to prevent corrosion.

As would be expected, the nature of the weathering conditions is important. These vary widely as, for example, the comparatively innocuous atmosphere of a suburban area, industrial areas largely polluted with sulphur dioxide, and marine situations where chlorides are present. In all these cases, moisture is nearly always present either as rain or as condensation. This moisture clinging to the surface absorbs gases from the air and acts as the corrosive medium. Sulphur dioxide is present in the atmosphere in almost any part of the British

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Isles, but to a much greater extent in industrial situations than in country areas. Solid particles in the air in industrial surroundings also contribute to corrosive effects. In consequence, an alloy exposed in urban areas may for some time show good corrosion resistance, but in industrial or marine situations may, within the same period, give marked evidence of corrosion.

A measure of protection of a cast aluminium surface against corrosion can be given by anodising it. This is the electrolytical production of a film of aluminium oxide that is "sealed" or hardened into position by a subsequent chemical process. The degree of protection afforded by any such film is difficult to assess. There is evidence to show that the degree of protection depends upon the natural resistance of the alloy itself; the more resistant the material, the better protection this oxide film will give. There is also evidence to suggest that protection is increased by increasing the thickness of the film.

The measurement of the degree of protection given by such an oxide film is a very lengthy process. Tests of an accelerated character often give misleading results and field tests on corrosion are essential if reliable results are to be obtained.

Production requirements of housings for floodlighting projectors or street lighting lanterns demand the minimum amount of machining of castings, and high corrosion resistant aluminium alloys that die-cast well are very desirable. The designer in his choice of materials is to some extent guided by the fact that the housing is almost certain to be painted. The bright finish of aluminium paint is popular and experience has shown the aluminium powder which acts as the pigment in such paint has good "leafing" properties that contribute to the prevention of water seepage. Whatever top coat is used a priming paint with inhibiting properties suited to an aluminium surface is desirable. It is also desirable that the alloy should have a pre-treatment which may take the form either of anodising or of a chemical dip. Such pre-treatment assists the adhesion of the paint. This pre-treatment is comparable with that used on ferrous materials such as sandblasting or a phosphate dip to give a key for the paint.

The weathering of the housing is, however, not the only problem associated with aluminium alloys. There is also the problem of the corrosion resulting from the galvanic action of dissimilar metals. Ideally, perhaps, aluminium housings should have aluminium fitments. With very few exceptions, however, aluminium fitments are either not available or are unsatisfactory mechanically. In general, from strength considerations, the designer is practically forced to use ferrous materials and stainless steel or mild steel with good coatings of cadmium or heavy galvanising should give satisfactory results.

In some respects it might be convenient to regard these fitments in two groups. In one group are nuts, bolts, etc., used in the normal assembly of the unit. In the other are those in constant use, such as clips and hinges. There should, for example, be no more difficulty in removing the terminal box of a floodlight after some years of use for, say, rewiring the lampholder than in the much more frequent adjustment of its focusing controls.

An interesting example of galvanic corrosion and of its relation to different methods of protection was found in some exposure tests on aluminium alloy slabs fitted with phosphor bronze screws. A slab which was anodised and painted showed only dark rain tracks near the screws. A slab which was anodised but not painted showed evidence that the anodic film was being penetrated near the screws. In a slab of raw material the alloy was powdered away near the screws. In all these slabs the metal remote from the screws was much less affected. As might be expected, these effects were more pronounced in marine and industrial areas than in urban surroundings. It is thus evident that the contact of unsuitable dissimilar metals may break down the resistant properties of an anodised film and also attack the resistant properties afforded by paint.

Aluminium Reflectors

Sheet aluminium is often used as a reflector in street lighting and floodlighting equipment. The weathering of this material when electrically brightened and anodised has been discussed elsewhere,* with the conclusion that unless particular care is taken in the fitting design to prevent the ingress of mois-

* Harper and Morton. Trans. I.E.S. (London), XI. August, 1946.

ture, it is undesirable for outdoor lighting equipment. With this proviso, it should give good service, not merely in street lighting units, but in floodlights and other outdoor projectors. It is, in fact, used in present-day street lighting units using tubular fluorescent lamps, and will also give good service for general interior lighting purposes such as shop interiors and the lighter industries. Anodised aluminium can be processed to give degrees of diffusion or spread reflection as an alternative to the more usual highly specular finish.

Silvered Glass

Considerable progress has been made in recent years in the quality of silvered glass reflectors. Glass lends itself very well, either by bending or blowing techniques, to shaping into designed contours and this advantage often outweighs the handicaps of fragility and weight. It is essential that the silvering should have good endurance. Early types of floodlights had their reflectors built up of small silvered glass facets with ordinary commercial backing to the silvering, but these floodlights were not always watertight and the ingress of moisture in due course resulted in the failure of the backing.

At a later stage similar assemblies of silvered glass facets were built up into a composite reflector for street lighting. In this instance, however, the facets were cemented into position on the underside of an open cast iron housing. The fronts of the facets were exposed to the atmosphere, but their sides and back were embedded in the cement which protected them from atmospheric attack.

The development of waterproof floodlights with the increase of wattage of the lamps employed led to thermal endurance problems on the silvering. Satisfactory results at reasonably high operating temperatures can now be obtained with reflectors in which the coating of silver is protected by a plated copper backing on which lead is deposited. Such protection must cover not only the back of the reflector, but also its edges so that there is no possibility of moisture reaching the silvering. The success of the process depends on depositing an adequate thickness of lead of good adherence, and this may be difficult if the glass shape has sharp corners or re-entrant contours. Such shapes, however, tend to produce strains in the glassware, so that in general it may be said that glass designs which are strong mechanically can also be silvered and lead backed satisfactorily.

Other Reflectors

Reflectors made of white vitreous enamel give good service, but once they are damaged, air and moisture penetrate below the glazed surface, corrosion of the metal results and the glazing breaks away. White enamels and paints are somewhat unsatisfactory for use outdoors or at high temperature. In the interior of a street lighting unit, for example, the principal problem is discolorisation due to heat. As yet there appears to be no satisfactory finish that will withstand such continued use and the only solution to such a problem is vitreous enamel.

It is probable that the only material used in exterior lighting equipment that weathers well is glassware. Recently, however, sheet "Perspex" has been used in outdoor units. It has the advantage of lighter weight and less fragility than sheet glass and can be easily cut or bent into most required shapes. It has, however, definite temperature limitations, but this problem is probably less serious for outdoor than indoor lighting equipment.

Conclusion

In conclusion it may perhaps be mentioned that practically all engineering materials will corrode.

This tendency can be combated by proper maintenance. Painted surfaces should be repainted before the breakdown of the top coat commences; preferably with a paint intended to suit the original finish. Trouble at hinges and joints—often junctions of dissimilar metals—can usually be met with suitable greasing. In street lighting lanterns or any other outdoor units, maintenance is not merely the cleaning of glassware and the replacement of lamps to meet photometric requirements; it is the conditioning of the units as a whole. Maintenance is admittedly expensive, but so also is outdoor lighting equipment and better attention to maintenance will lengthen the useful life of the equipment.

The Effect of Light and Colour on Feeling

Quoted from Outlines of Psychology by Harald Höffding, Professor at the University of Copenhagen; published in English by Macmillan and Co. in 1892.

In the influence exerted on feeling by **light** and **darkness** we are reminded of the great contrasts in the vital feeling. It is certainly necessary to look farther back than the visual sensations to understand the great influence of light on all creatures that have sensuous perception. The influence of light is . . . a condition of the conversion of inorganic into organic matter. Light is thus one of the most elementary conditions of life. Plants turn to the light, and if light enters on more sides than one, they turn to the side where it is strongest. Light promotes metabolism in animals, more especially in the respiration; even creatures without eyes breathe more quickly in a bright than in a dark atmosphere. That the influence of light upon the eye should promote metabolism is explained by some as due to a reflex action of the visual nerve upon the central organ of the vaso-motor nerves. The satisfaction taken in light and the dislike of darkness therefore constitute even a part of the general vital feeling, and the way in which at all stages of civilisation men have associated light and life, darkness and death, testifies to a profound and constant experience. Other experiences besides the immediate general sensations have undoubtedly helped in this: light brings with it security, while darkness favours foes and dangers. The real basis, however, does not lie in these associations.

The pleasure in light has, however, yet another source, which is not, like that just mentioned, immediately derived from the instinct of self-preservation. The organ of sight, like every other, requires activity, and its natural, normal functioning is accompanied by pleasure, as appears to be the case with all normal functioning. When even the eyes of the new-born infant turn to the light, this is not wholly on account of the quickened process of metabolism, but also on account of the impulse to natural function. Dislike of darkness is, therefore, also the expression of an inhibited impulse to activity.

Light does not, however, satisfy the eye. The visual organ desires to be filled with colours. "Let it be remembered," says Goethe, "how our spirits revive when on a dull day the sun shines out over a single part of the landscape, and makes its colours visible. The attribution of medicinal virtue to coloured precious stones may have arisen out of the deep sense of this unspeakable delight." The effects of colour on feeling are in part dependent on the degree of clearness—that is to say, the degree in which colours approach to white; in part on their "saturation"—that is to say, the degree in which colours approach the spectrum shades; in part, therefore, on the achromatic, in part on the chromatic element in sensation. The duration and the compass of the excitation are also of importance; thus pain results from the too protracted or too extensive application of a stimulus, which if less extended (either in time or space) would afford pleasure. The greater the depth of colour, the smaller must be the extension, if a feeling of pleasure is to arise.

In respect of the influence of the different colours upon feeling, Goethe had already demonstrated that colours may be divided into two classes, which he called the positive and negative, but which with Fechner we may perhaps rather call the **active** and **receptive** colours. The active colours—namely, purple, red, orange, yellow—have a stimulating effect, excite activity and movement. The receptive colours, among which may be reckoned blues, are depressing and subduing, and do not conduce to external activity. Yellow and dark blue serve as the typical representatives of the two sets, and the difference between their influence upon feeling strongly recalls the difference between the influence of light and of darkness upon feeling. Goethe describes the frame of mind induced by looking at a landscape on a dark winter's day through yellow glass as follows: "The eye rejoices, the heart expands, the mind is cheered; an immediate warmth seems to breathe in on us." With diminished illumination the energy of the active series is subdued; with augmented illumination, all colours approximate to white, and the effect on feeling sustains a corresponding change.

Structure of Coloured Glass

In a short Chairman's Address to the Physical Society's Colour Group on Friday, March 19, Mr. J. G. Holmes reviewed the activities of the Group since its inception in 1942. He showed, by interesting graphs and tables, how the membership had risen to its present figure (214), how the papers were distributed over various aspects of the subject and how the "consumer interest" was reflected in the attendances at the meetings. During the discussion the desire was expressed to hear more in the Group of the chemical problems related to colour.

Mr. Holmes followed his address with a paper entitled "The Physical Structure of Coloured Glass." He outlined the current theory of the constitution of glass as an irregular network, usually with silicon and oxygen atoms as the main constituents, in the interstices of which were located the atoms of so-called network-modifier substances. The selective light absorption attributable to the atoms of a given element in glass depended on the valency state of the atoms and on whether they formed part of the network or were present as network modifiers. This generalisation was illustrated by a table showing the various colours resulting from the various elements commonly incorporated in coloured glass. Mr. Holmes explained that as regards methods of manufacture and the standard physical properties—hardness, refractive index, dispersion, etc.—of the final product, coloured glasses differed little from the corresponding white glasses.

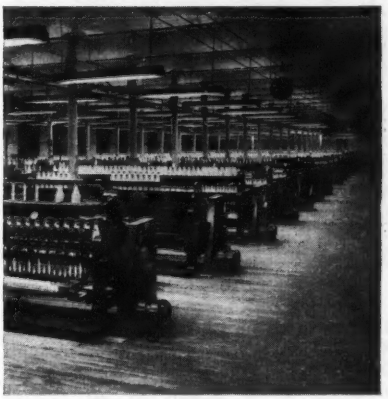
A pleasant feature of the meeting was the very warm vote of thanks to the retiring secretary, Dr. W. D. Wright, who had served the Group, first as chairman and then as secretary, since its formation. Mr. R. G. Horner was elected to succeed Dr. Wright.

Members of the Illuminating Engineering Society might like to be reminded that they may become members of the Colour Group of the Physical Society on payment of an annual subscription of 5s. Applications should be addressed to the Secretary (Colour Group), The Physical Society, 1, Lowther Gardens, London, S.W.7.

Lighting in a Textile Mill

Metrovick Illuminating Engineers have recently redesigned the lighting at the Chadderton Mill of Messrs. S. Bourne and Company, Oldham. This doubling mill has a weekly output averaging 55-66,000 lb. fine count yarn, which is used in the manufacture of poplin, shirtings, dresses, hosiery, curtains, etc. Included in the complete reorganisation which has taken place is the painting of walls, ceilings, and machinery in attractive colours, and the repositioning of the batteries of machines to take full advantage of the new lighting.

In order to make sure that fluorescent lighting was the most suitable



experiments were carried out for several months and the operatives' reactions and opinions were studied. A close watch was also kept on the quality and quantity of thread produced.

The new lighting scheme was planned to give levels of illumination in accordance with the I.E.S. Code, and throughout the mill the illumination has been increased from four to six times its previous level with an increase in the total power load of 12 kw.

The mill operatives have expressed their satisfaction at the ease with which they can now see the fine threads, and the management report improvement in the rate of production.

Street Lighting in the Midlands

Three fluorescent street-lighting installations, planned by The British Thomson-Houston Company, Ltd., recently came into operation at Leamington Spa, Wolverhampton, and Worcester.

In The Parade, Leamington, 10 Mazdalux fluorescent street-lighting lanterns, each accommodating three Mazda 80-watt "warm-white" fluorescent lamps, are mounted on existing standards placed along the centre of the roadway, at a height of 25 ft.

The Parade, Leamington.

Similar lanterns have been installed in North-street, Wolverhampton, and Deansway, Worcester. These also are mounted at a height of 25 ft. on brackets clamped to existing standards.

The Mazdalux fluorescent street-lighting lantern used in these installations is of silicon-aluminium alloy construction and has a translucent plastic cover. All the auxiliary apparatus is accommodated within the lantern and hinged end-covers enable lamp changing and starter switch maintenance to be carried out with the plastic cover remaining in position. A separate reflector is used for each lamp and the lamps are so arranged that the lower of the three may be used alone for late night economy lighting. The lantern has an output—average over lamp life—of 6,380 lumens, and 97 per cent. of this available light is directed below the horizontal.

Dow Golf Cup

We have been asked to give some further details of the golf competition for the Dow Cup. (See March issue, p. 64.)

The qualifying competition will consist of 18 holes medal round played on any recognised course before June 12. The final will consist of 18 holes stroke play at Harrogate on Saturday, June 19, the number of finalists depending on the scores in the preliminary round. Those to take part in the final will be notified by the Golf Sec. before the Summer Meeting.

It is hoped that many I.E.S. members will take part in this competition, the proceeds of which will be allocated to charity.

Human Factors in Industry

A conference on the above subject has been arranged to take place, under the auspices of the British Association for the Advancement of Science, at Leamington Spa on May 8. The proceedings involve two sessions, the first of which deals with working conditions. The chairman of this section is Sir Henry Tizard, and we are glad to note that an address on the subject of lighting, by Mr. H. C. Weston, is to figure in the proceedings.

Shorter Fluorescent Lamps

The Electric Lamp Manufacturers' Association announce that from July 1 next the range of fluorescent lamps will be extended by the introduction of two new types, each two feet in length. They will be a 20-watt lamp, 1½ in. in diameter, which will be on sale at 12s. 6d. each, and a 40-watt lamp, also of 1½ in. diameter, which will cost 14s. each.

The lamps will be fitted with standard bi-pin caps and will be available in daylight and warm-white colours, the efficiencies will be some three or four times that of the corresponding tungsten lamps.

The EDITOR Replies

I have been interested to get further news of Mr. R. Gillespie Williams, who tells me that the name of the body of which he is president, and whose headquarters are located in New York, has been altered to "*The Color Lighting Corporation.*" Another organisation in the name of Mr. Gillespie Williams has, however, been formed to deal exclusively with professional consulting work.

The remarks in our January issue in regard to *Hospital Lighting* (p. 23) have brought us a letter from Mr. Willard Allphin, of New York, who kindly sends us several copies of a paper entitled "Lighting in the Hospital Patient's Room," contributed by himself and others to *Illuminating Engineering* in 1947. This deals with only one section of hospital lighting, but an important one. The illustrations in the paper show various forms of fittings to facilitate reading in bed, mainly fluorescent and all highly diffusing. Light for the examination of patients is best furnished by special portable units. Control of lamps and switching arrangements are of great importance.

In the February issue of LIGHT AND LIGHTING (p. 43) I referred casually to the use of "calor gas" as likely to interest lighting experts called upon to furnish illumination in remote spots where neither gas nor electricity is available. I have now received from the Patent Lighting Company, Ltd, (Eden Works, Uxbridge-road, Hayes, Middlesex), some notes on the use in this connection of propane, which will remain gaseous at quite low temperatures and is easily handled in light cylinders.

For the situation mentioned (*loc. cit.*) requiring visibility at three-quarters of a mile, a small lantern with a 116-mm. lens and a very small burner giving about 20 to 25 c.p. will answer. This burner takes only about 0.35 cub. ft, per hour as a fixed light and considerably less if used with a flasher. Larger lanterns, with ranges up to 10 miles or so, are available.

Further information will be furnished to any members interested on application to the address named above.

I am indebted to Mr. Louis Povel, of Holland, for a sight of useful memoranda which he has prepared, analysing the lighting *equipment* of a considerable number of the *world's largest theatres*. Besides leading theatres in France, Germany, Austria and Holland some more remote installations such as that in the State theatre in Teheran, Persia) are mentioned. Equipment is studied in terms of footlights, borderlights, projection apparatus, cyclorama, etc. The Metropolitan Opera House, New York, and the Soviet Palace, Moscow, appear to be amongst the most lavishly equipped, though Covent Garden stands out will in cyclorama equipment.

I was asked recently for information on the most up to date method of

lighting billiard tables. This is one case in which the time-honoured method of lighting has much to recommend it. By this method the filament lamps are completely concealed from the eyes of players and spectators by the deep conical cardboard shades, white inside but with a green exterior. The large inner surface of the shades also serves well to diffuse the light. To secure even illumination, however, the units should be closely spaced. I imagine six is the minimum for a full-size table.

One other point may be noted, the expediency of using internally frosted lamps so as to eliminate any possible striations such as are liable to be found with clear bulbs. (I notice that the *I.E.S. Lighting Review* (Australia) recently recalled that Walter Lindrum was in the habit of carrying with him a small attache case containing a number of internally frosted lamps, which he installed over whatever table he was going to play upon!)

The same journal describes what is doubtless the most modern system of all, now in use at the Victorian Club, Melbourne. Each table is lighted by a rectangular frame supporting two 40-watt fluorescent lamps in enamelled reflectors, a "tulamp ballast" being installed to prevent any possible stroboscopic effects. With such units mounted 3 ft. above the table an illumination varying from 45 to 63 ft.-c. was obtained. The colour-rendering is good, and it is remarked that there are now no bright spots on the balls, such as are in evidence when filament lamps are used.

As we go to press I learn that the process of obtaining a bulk supply of copies of the *Lighting Handbook*, published by the American I.E.S., is, after all, proving less formidable than was feared and that permission has at length been secured to export the necessary dollars in payment. Members of the I.E.S. who have applied for copies may therefore hope that in due course they will obtain them through this source, though it may still take some little time before they actually arrive.

We learn with interest that the Ettles Lecture for this year is to be given by Mr. H. C. Weston, who, we understand, will deal both with lighting and vision, dwelling especially on their role in industrial processes.

It may be recalled that the Ettles Lectures are foundation lectures inaugurated by the Institute of Ophthalmic Opticians and are now being perpetuated by the Association of Optical Practitioners.

SITUATIONS VACANT

ASSISTANT ENGINEER required for development work on Fluorescent Lamp Auxiliaries. H.N.C. standard or equivalent, experience in photometry an advantage. Salary according to qualifications and experience. North London. Apply, Box 774, "Light and Lighting," 32, Victoria-street, London, S.W.1.

ILLUMINATING ENGINEER of degree standard required for practical and experimental work in connection with the manufacture and design of road vehicle lighting equipment. To carry out tests on new designs and to check and maintain production and the quality of production. The work involves technical liaison with suppliers. Age 25-30. State age, qualifications and experience. —Apply, Box 775, "Light and Lighting," 32, Victoria-street, London, S.W.1.

FULLY QUALIFIED ILLUMINATING ENGINEER required by leading manufacturer (E.L.M.A. and E.L.F.A.) for responsible and senior position in sales organisation in Lancashire Area. Applications will be treated as confidential, and should give full details of experience, age, and salary required.—Box No. 776, "Light and Lighting," 32, Victoria-street, London, S.W.1.

The WESTON Photometer

The Weston Model S85 Photometer is a new simple pocket size instrument of the photo-electric type designed for the measurement of interior illumination values. It has two ranges of 0 to 25 and 0 to 125 ft. candles and gives an instant indication of light intensities. No technical knowledge or accessories are required for this photometer which is always ready for use. It is housed in a neat bakelite case measuring only 2″ × 3″ × 1 3/16″ and is precision built with a movement incorporating spring loaded jewels. Sensitive and robust, this new Weston instrument is designed to give a lifetime of dependable service. Please write for details.

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Reviews of Books and Publications Received

Shadow and Diffusion in Illuminating Engineering. By K. Norden. Pp. 165 + x. *(Pitman. Price* 25*s.)*

Dr. Norden is well known to all lighting engineers as a lifelong worker in the subject about which he has written in this book, but why did the publishers not arrange for it to be edited by an English lighting engineer? It is most irritating to a reader who is trying to follow the author's reasoning if his attention is distracted every few lines by an unfamiliar word or a phrase which has to be read twice before its meaning can be grasped. What, for example, is a *calotte*? and is "reductive vision" a happy term for "a mode of observing shadowed colours whereby the impression of a shadow is transferred into that of a change in the colour value"?

The matter of the book is strangely uneven in quality. Much of the formal treatment in the earlier chapters is either obvious or open to question; that in the section dealing with the shadow of a small disc cast by an extended source has apparently been written in ignorance of published work on the subject. On the other hand the descriptions of types of shadows, their uses and their modes of formation, could scarcely be bettered, but will the author's suggested method of calculating the "shadow factor" in an installation be accepted by the lighting engineer as a necessary further complication of his already complex task? Time will show, but meanwhile this book will perform a most valuable service if it persuades him to pay more attention to an aspect of lighting design which has been only too frequently neglected until now.

Textbook of Light. By R. W. Stewart and J. Satterley. Eighth edition, revised by H. N. V. Temperley. Pp. 406 *with* 264 *diagrams. (University Tutorial Press, Ltd. Price* 9*s.)*

This book is stated in the preface to be for the use of students preparing for the London Intermediate Science examination. It should, therefore, be of value to anyone preparing for the City and Guilds examinations in Illuminating Engineering, who is expected to have a knowledge of light up to Inter-B.Sc. standard before beginning his specialised course. This necessary groundwork is well covered and the book can be confidently recommended to such a student.

The section on photometry is well written and is unusually up to date in its treatment of the basic principles and its explanation of the fundamental quantities. In the present edition a page and a half have been added on physical photometry, but it is unfortunate that the form of rectifier cell described is the copper oxide cell, the selenium cell being mentioned only in passing. These pages require some revision in a future edition and the same remark applies to some other passages, e.g., where it is stated that "many of the cheap cameras on the market are simply pinhole cameras" and "in the modern lamp the filament is made of tantalum or tungsten." The figures of efficiency stated at the bottom of p. 274 are rather wide of the mark and most of the values of candle-power given in Table IV are useless, as they apply to sources such as the Welsbach mantle or the "electric bulb" for which no size or rating is given.